

Ceramics: Toughness and Self-Healing

Ceramic materials are known to have low toughness, which is a major limitation for their use, causing them to fail by cracking. But Nature has evolved some ceramics, such as bone and nacre, which have superior toughness and resist cracking very well. They do this in two ways. Firstly, they have multi-scale microstructures allowing for crack resistance at different size scales. And secondly, they are able to repair damage and adapt to local loading conditions, preventing catastrophic fracture in a way which is economic in its use of energy and materials.

This talk covers work by the speaker on both of these aspects. Multi-scale toughening mechanisms are discussed using a fracture mechanics approach known as the Theory of Critical Distances. Repair and adaptation of living ceramics is illustrated using two examples: bone and mollusc shells.